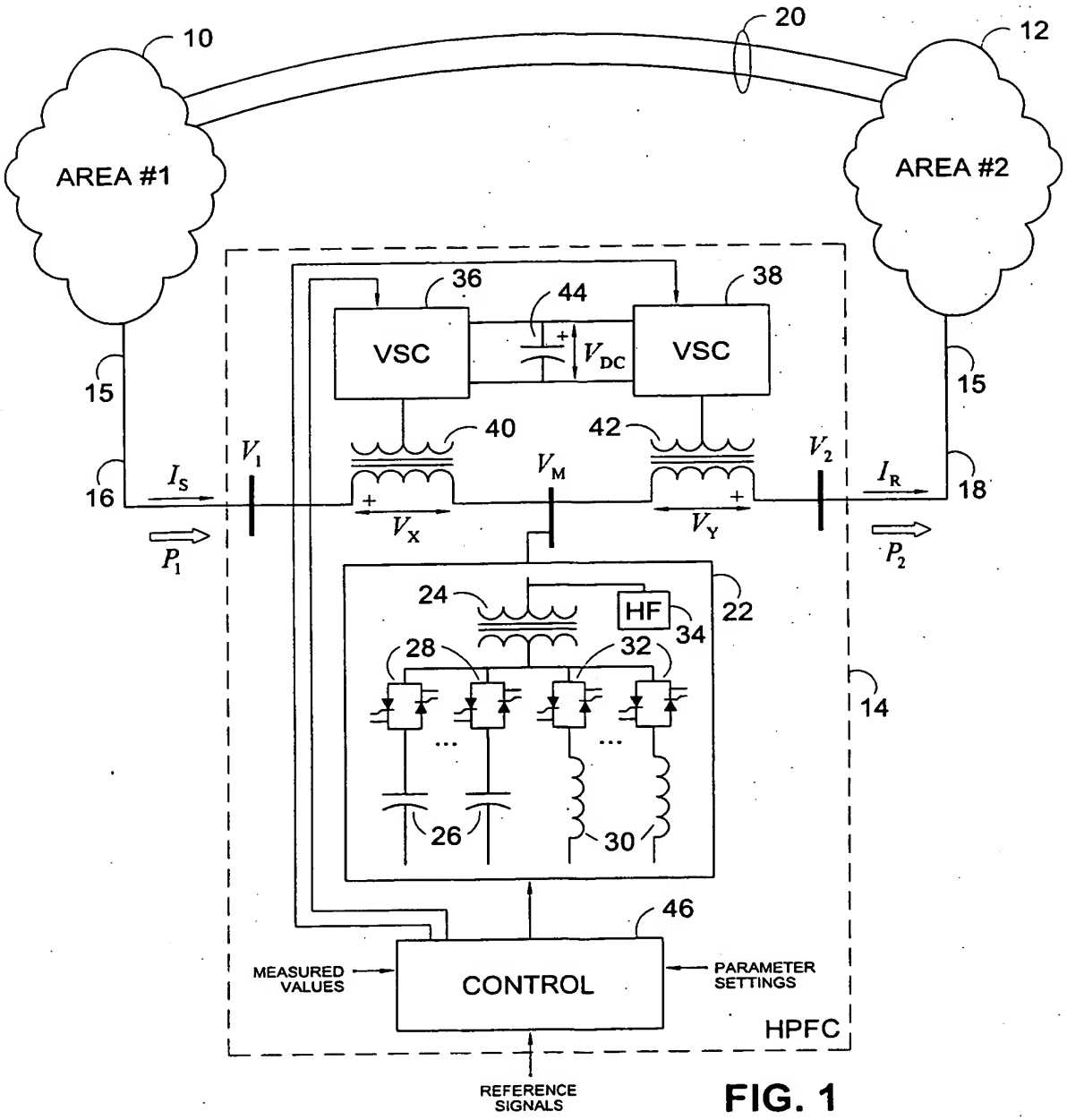

10
20
12
AREA #1
AREA #2
36
44
38
VSC
V_{DC}
VSC
15
15
40
42
V_1
I_S
V_M
V_2
I_R
16
18
V_X
V_Y
P_1
P_2
24
HF
34
22
28
32
14
26
30
46
MEASURED VALUES
CONTROL
PARAMETER SETTINGS
HPFC
REFERENCE SIGNALS

FIG. 1

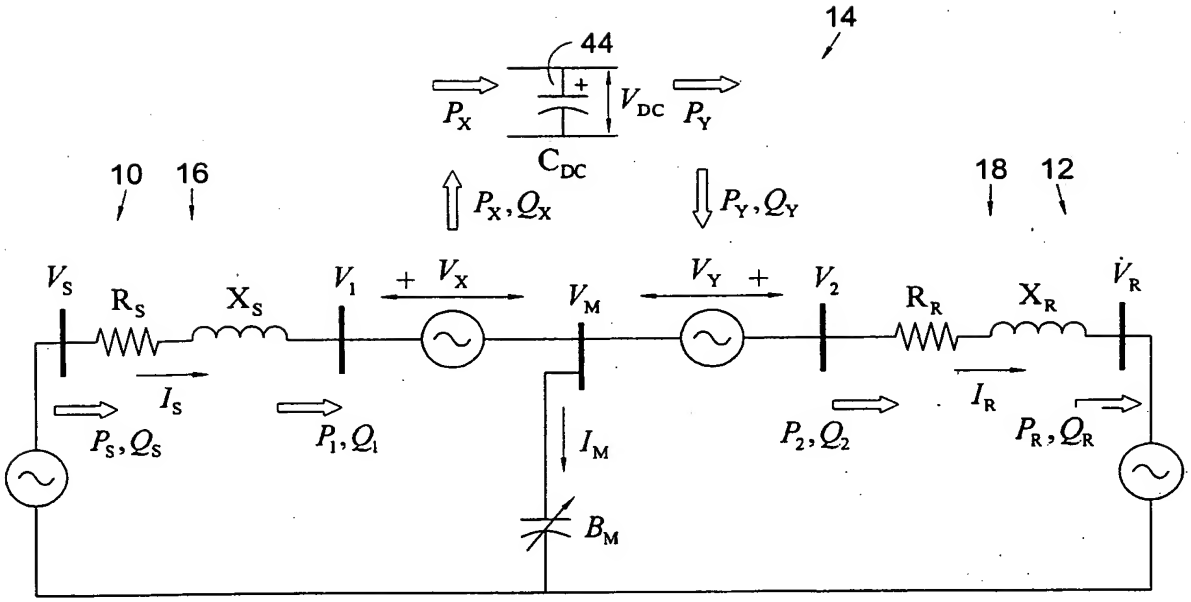

14
44
P_X
V_{DC}
P_Y
C_{DC}
10
16
P_X, Q_X
P_Y, Q_Y
18
12
V_S
R_S
X_S
V_1
$+ V_X$
V_M
$V_Y +$
V_2
R_R
X_R
V_R
I_S
I_R
P_S, Q_S
P_1, Q_1
I_M
P_2, Q_2
P_R, Q_R
B_M

FIG. 2

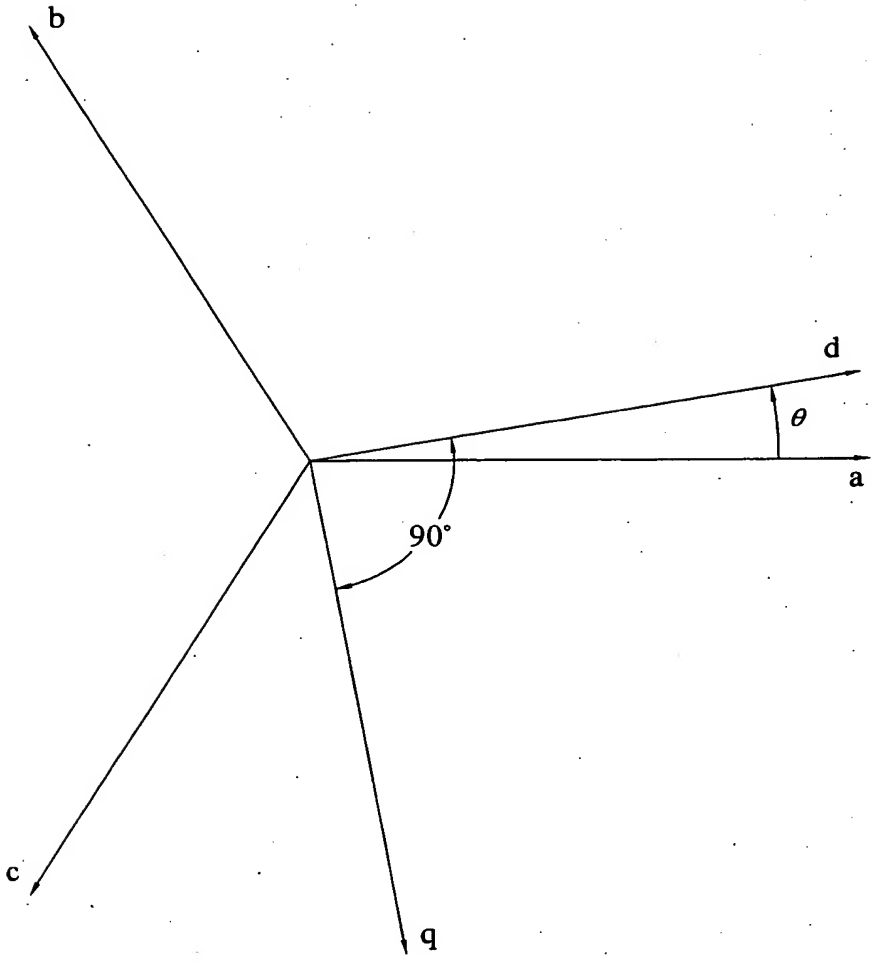


FIG. 3

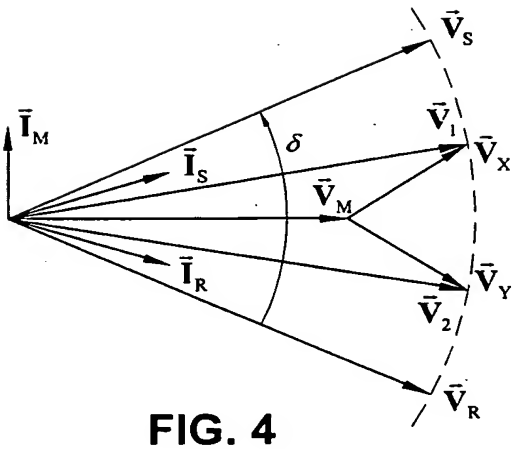

$\vec{V}_S$
$\vec{I}_M$
$\vec{V}_1$
δ
$\vec{V}_X$
$\vec{I}_S$
$\vec{V}_M$
$\vec{I}_R$
$\vec{V}_Y$
$\vec{V}_2$
$\vec{V}_R$

FIG. 4

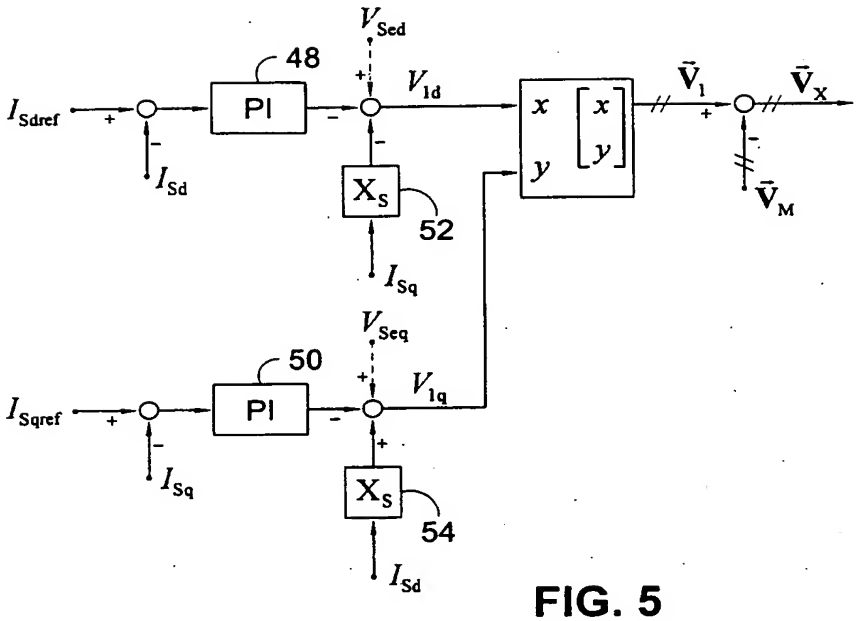

V_{Sed}
48
PI
I_{Sdref}
I_{Sd}
V_{1d}
X_S
52
I_{Sq}
V_{Seq}
50
PI
I_{Sqref}
I_{Sq}
V_{1q}
X_S
54
I_{Sd}
x
y
$\bar{V}_1$
$\bar{V}_X$
$\bar{V}_M$

FIG. 5

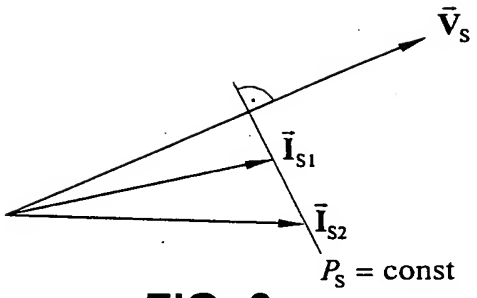


FIG. 6

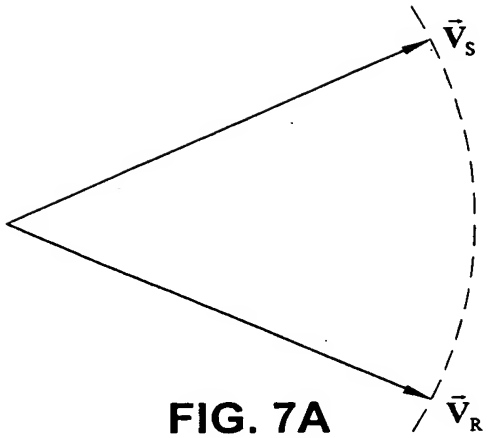


FIG. 7A

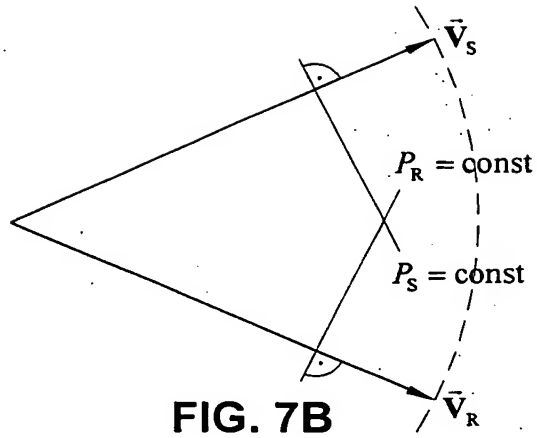


FIG. 7B

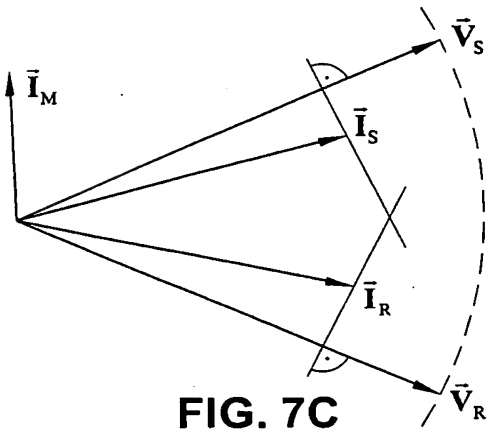


FIG. 7C

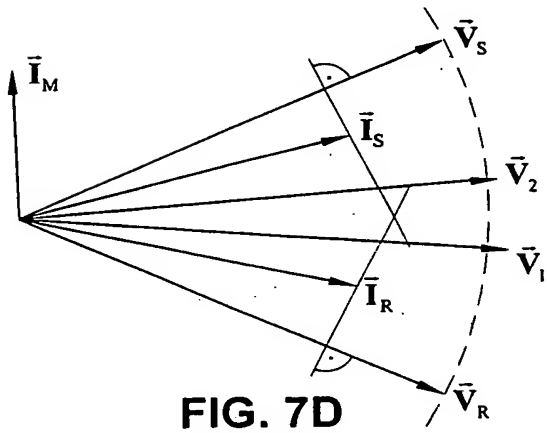


FIG. 7D

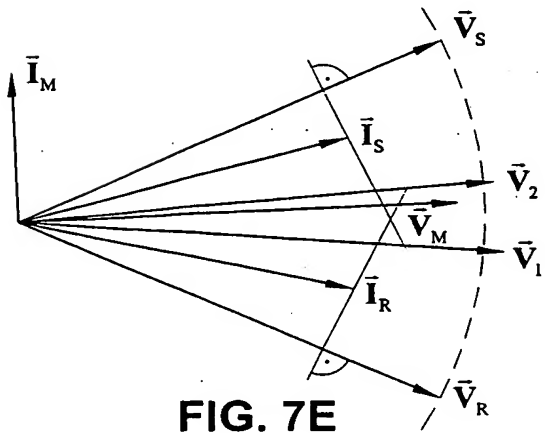


FIG. 7E

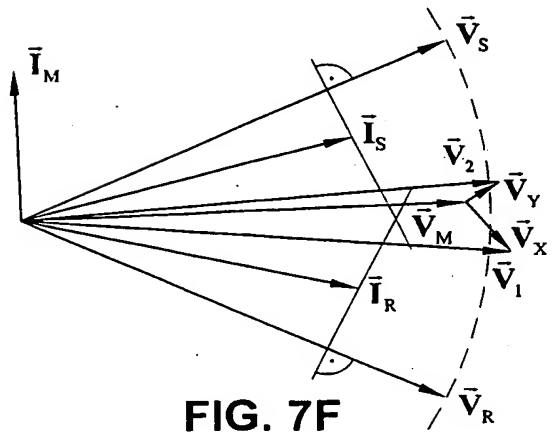


FIG. 7F

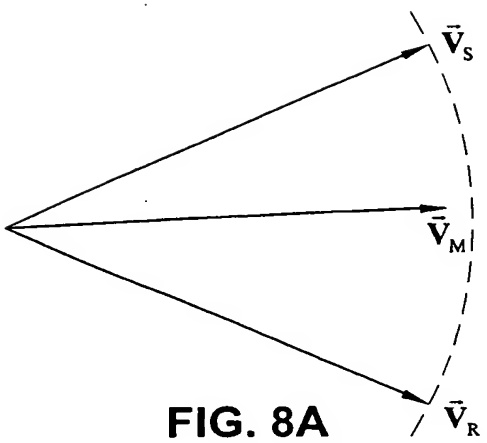


FIG. 8A

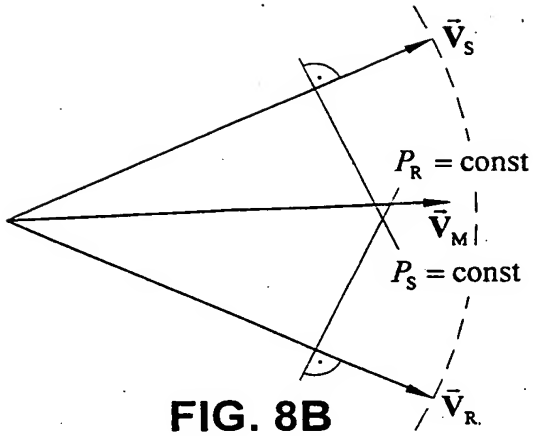


FIG. 8B

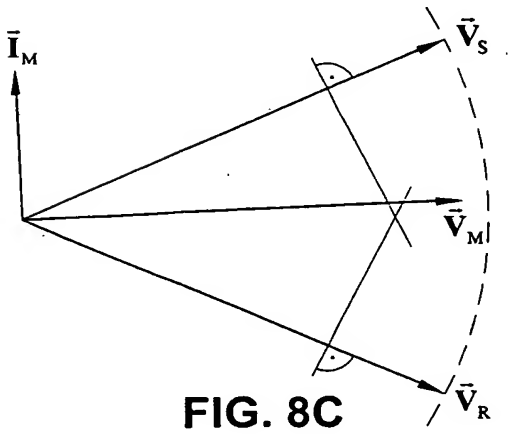


FIG. 8C

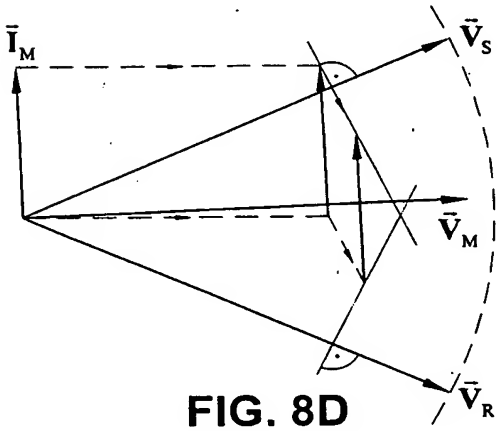


FIG. 8D

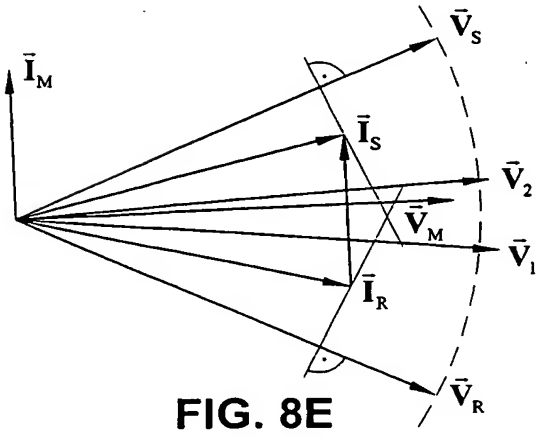


FIG. 8E

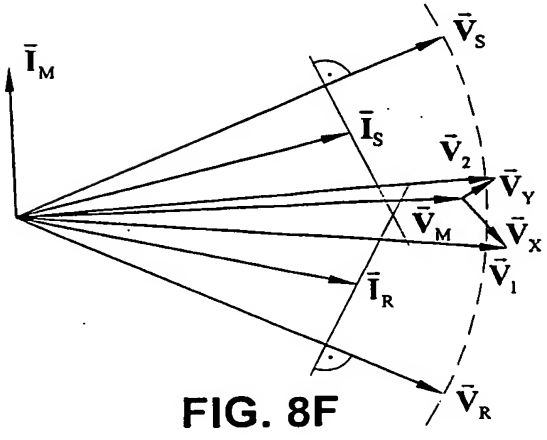


FIG. 8F

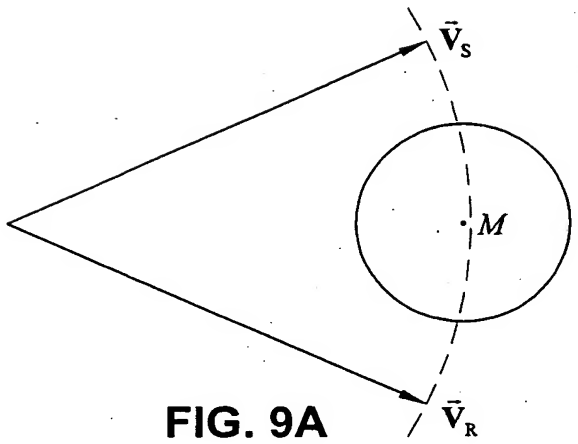


FIG. 9A

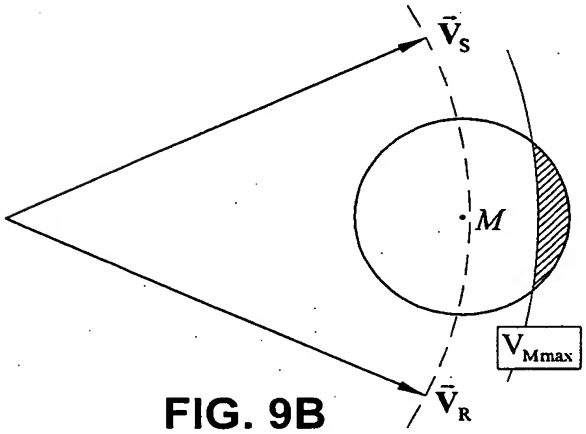


FIG. 9B

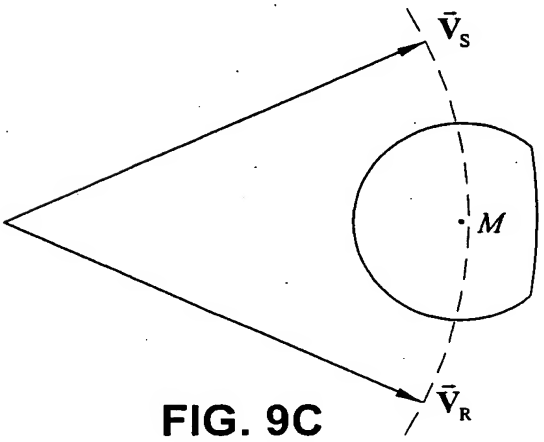


FIG. 9C

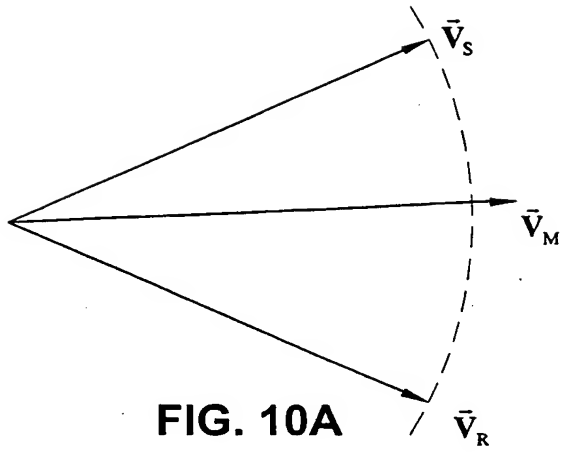


FIG. 10A

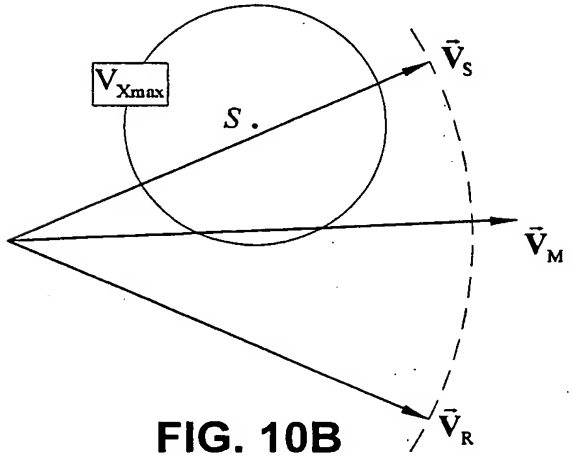


FIG. 10B

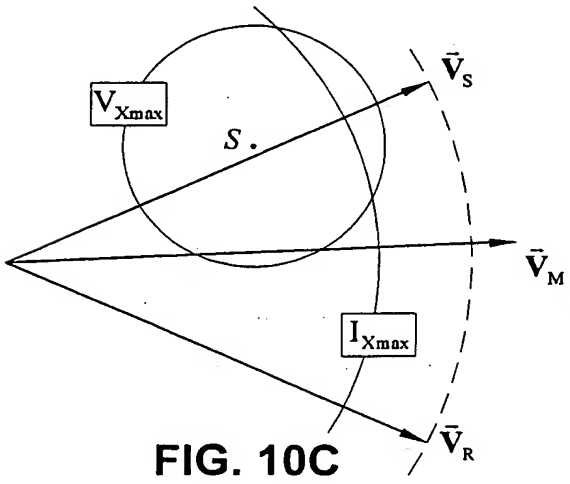


FIG. 10C

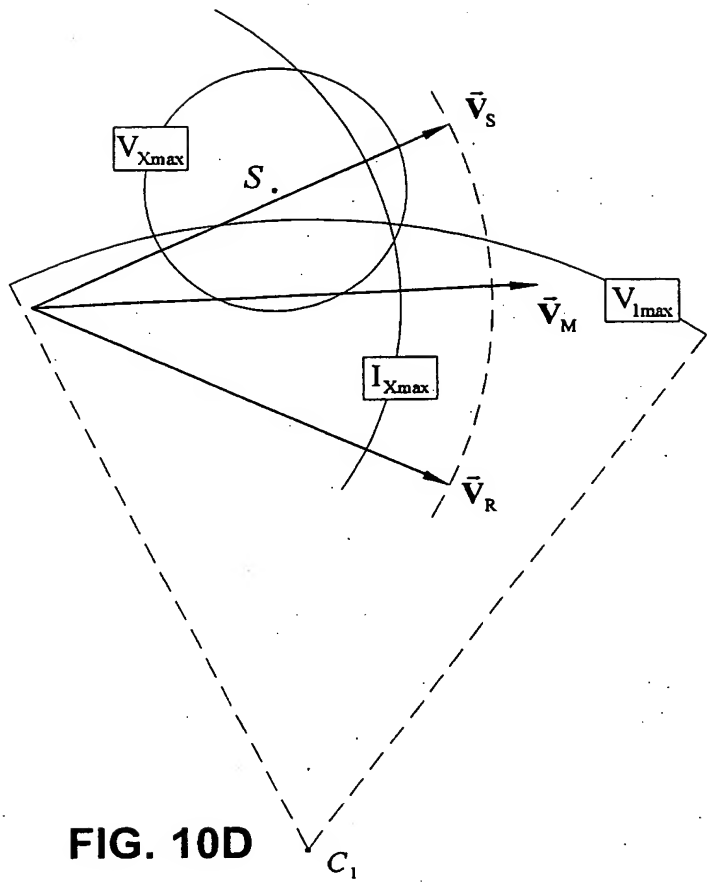


FIG. 10D

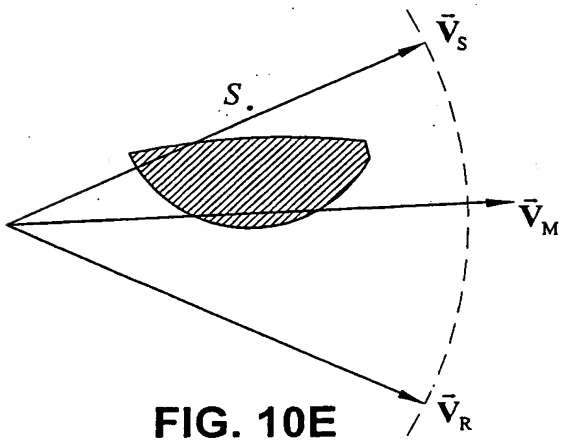


FIG. 10E

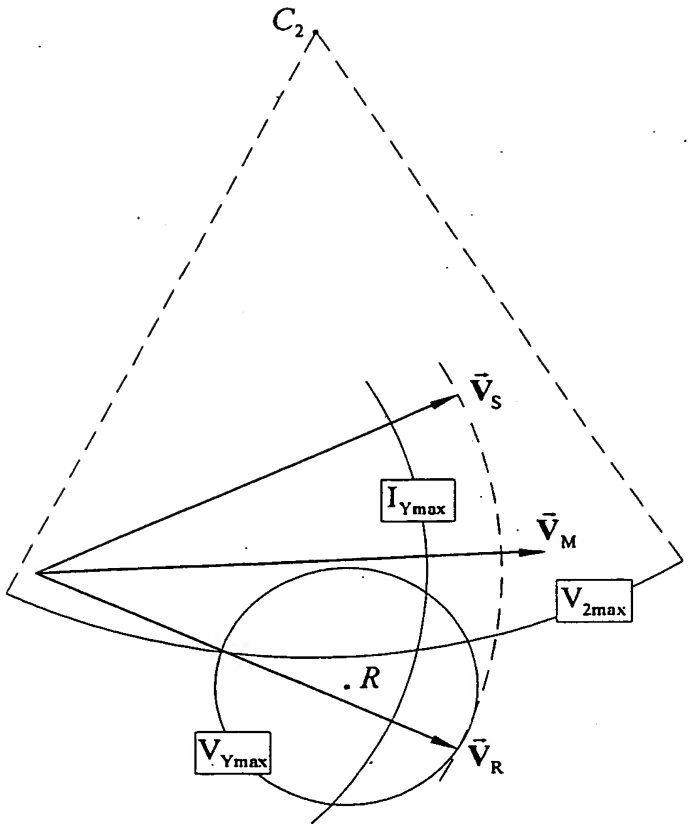


FIG. 10F

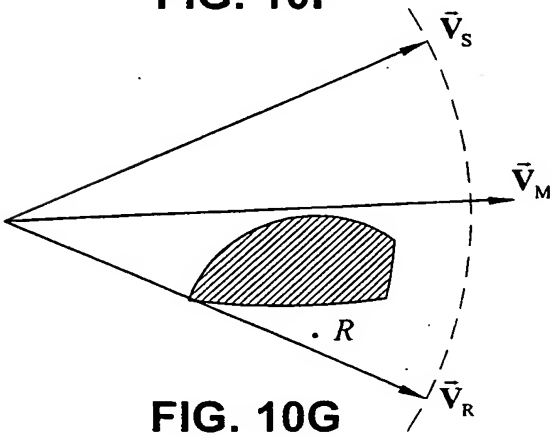


FIG. 10G

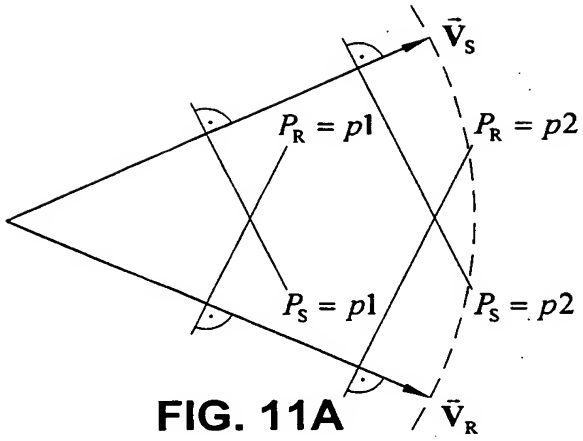


FIG. 11A

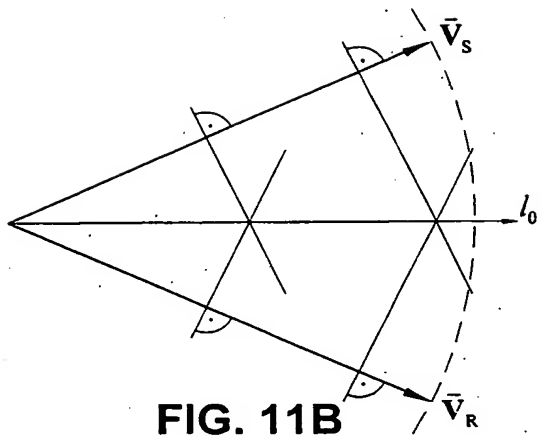


FIG. 11B

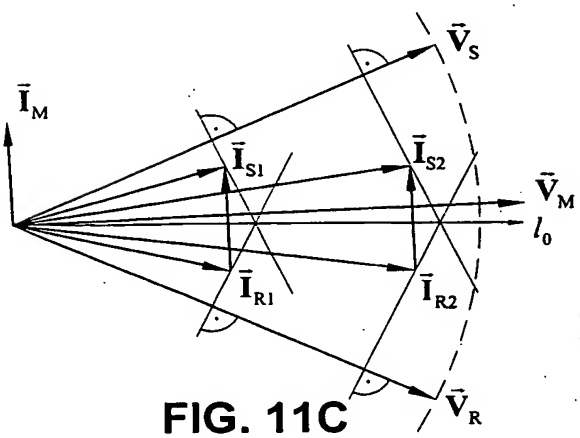


FIG. 11C

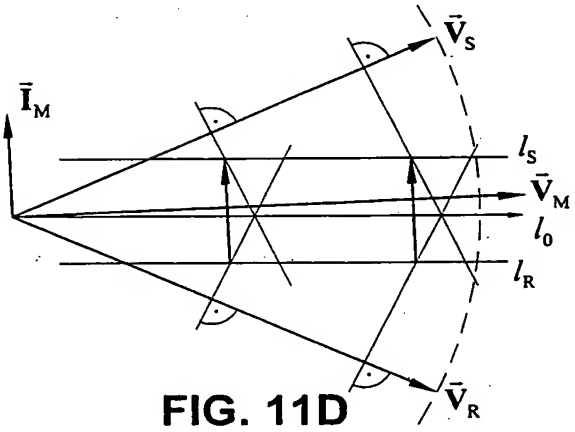


FIG. 11D

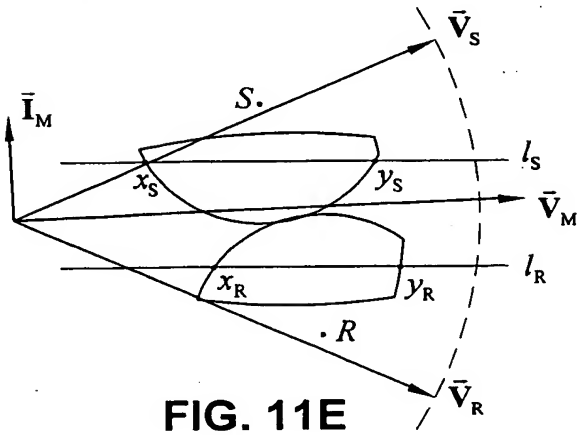


FIG. 11E

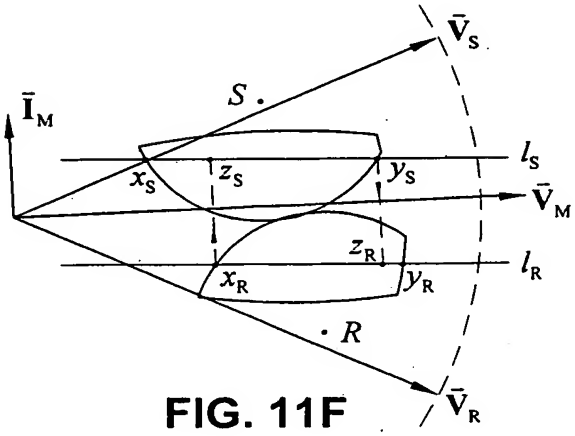


FIG. 11F

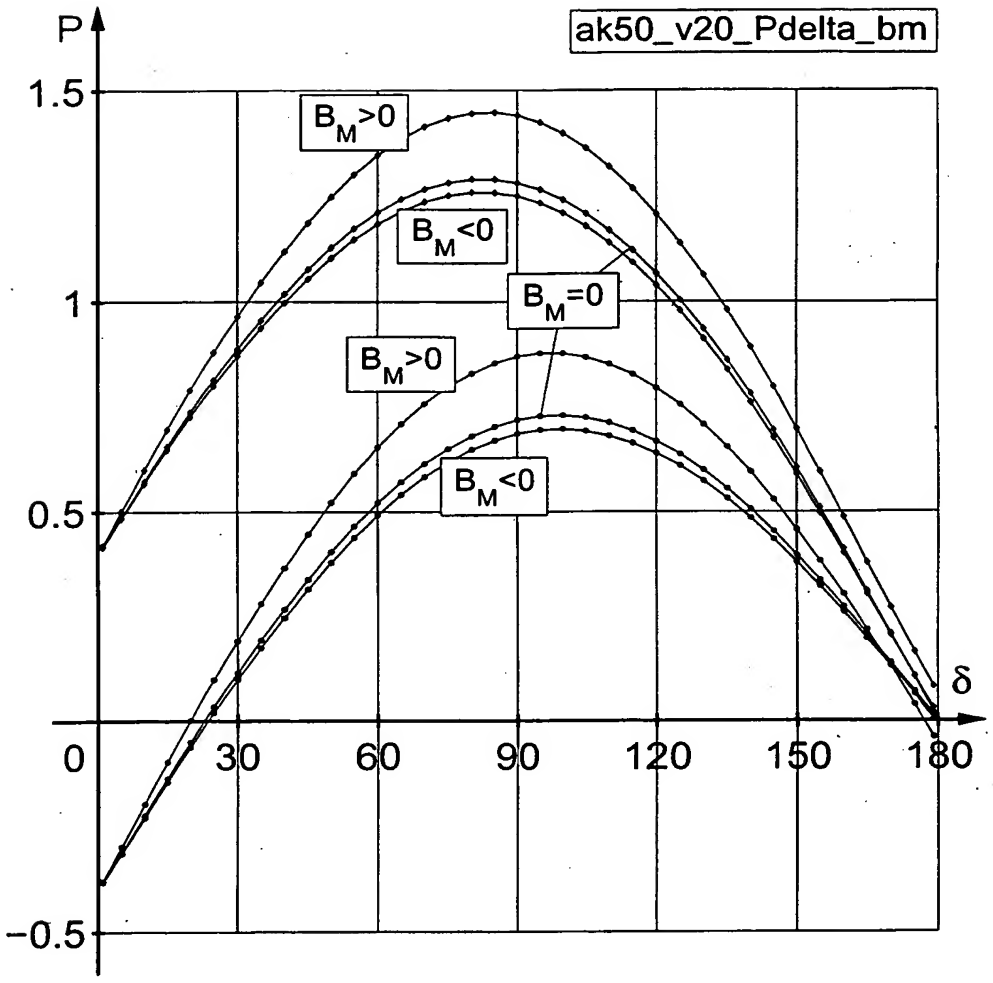

P
ak50_v20_Pdelta_bm
1.5
1
0.5
−0.5
0
30
60
90
120
150
180
δ
B_M>0
B_M<0
B_M=0
B_M>0
B_M<0

FIG. 12

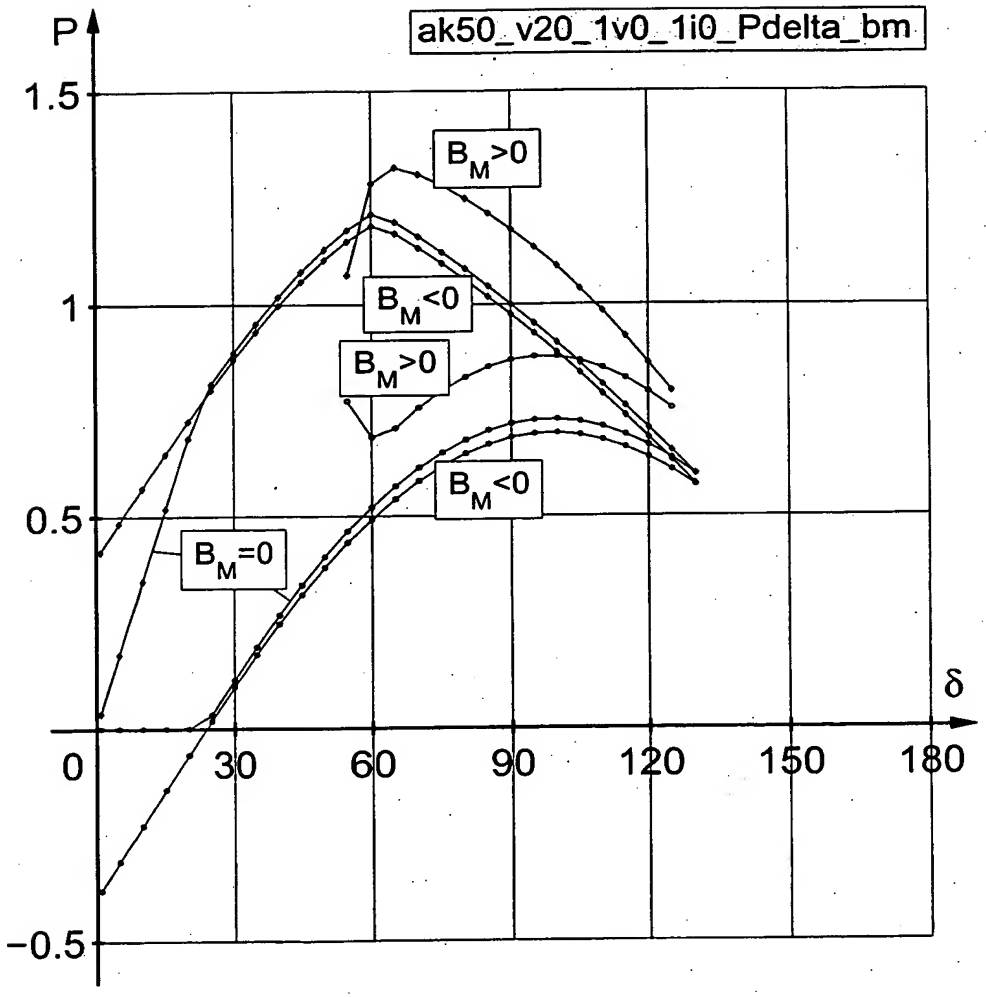

ak50_v20_1v0_1i0_Pdelta_bm
P
1.5
1
0.5
−0.5
0
30
60
90
120
150
180
δ
B_M>0
B_M<0
B_M>0
B_M<0
B_M=0

FIG. 13

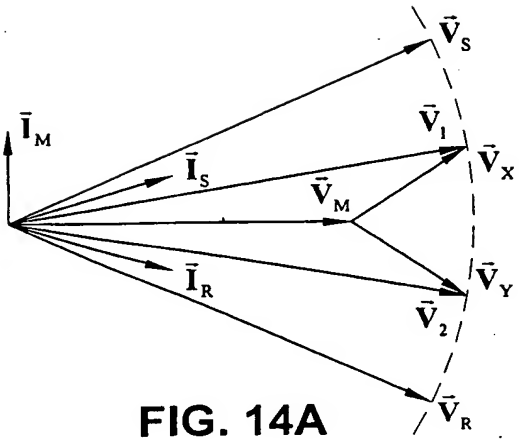


FIG. 14A

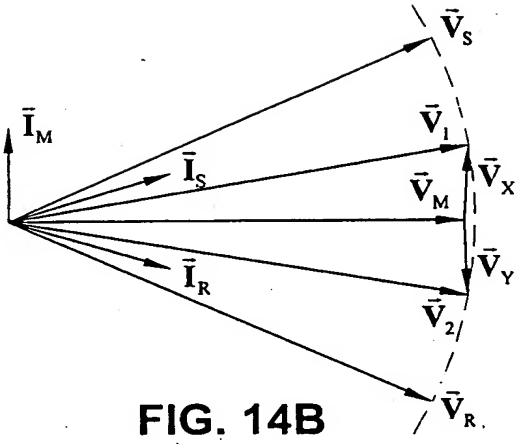


FIG. 14B

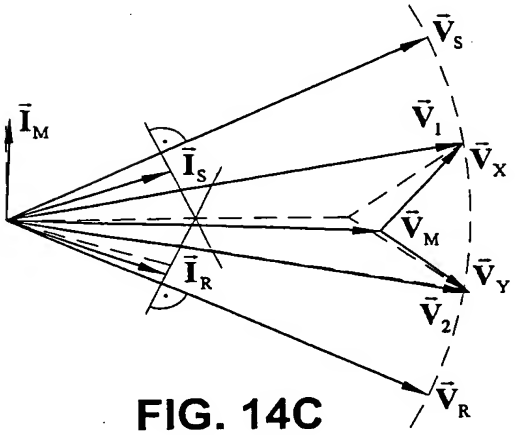


FIG. 14C

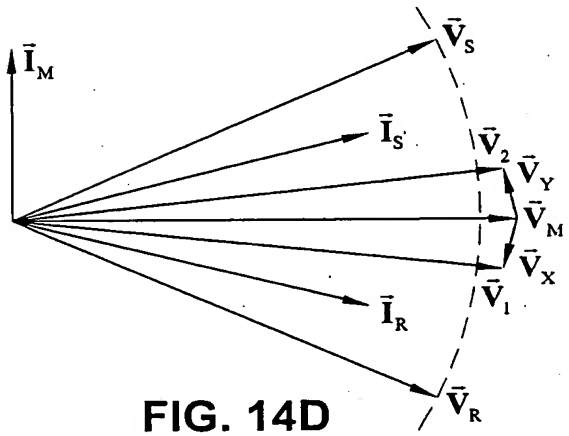


FIG. 14D

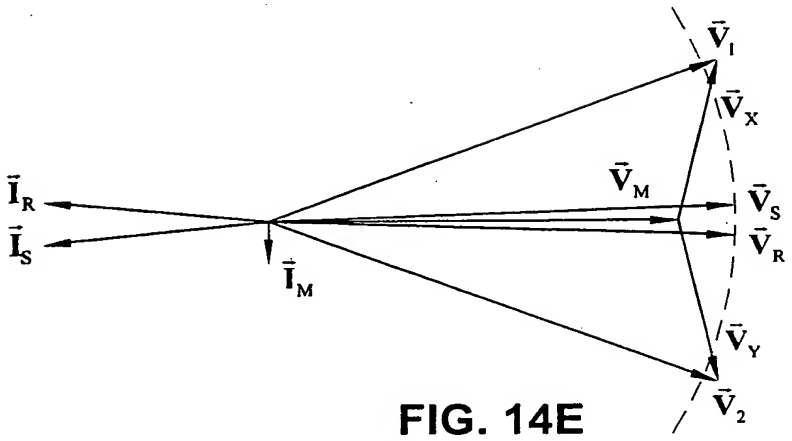


FIG. 14E

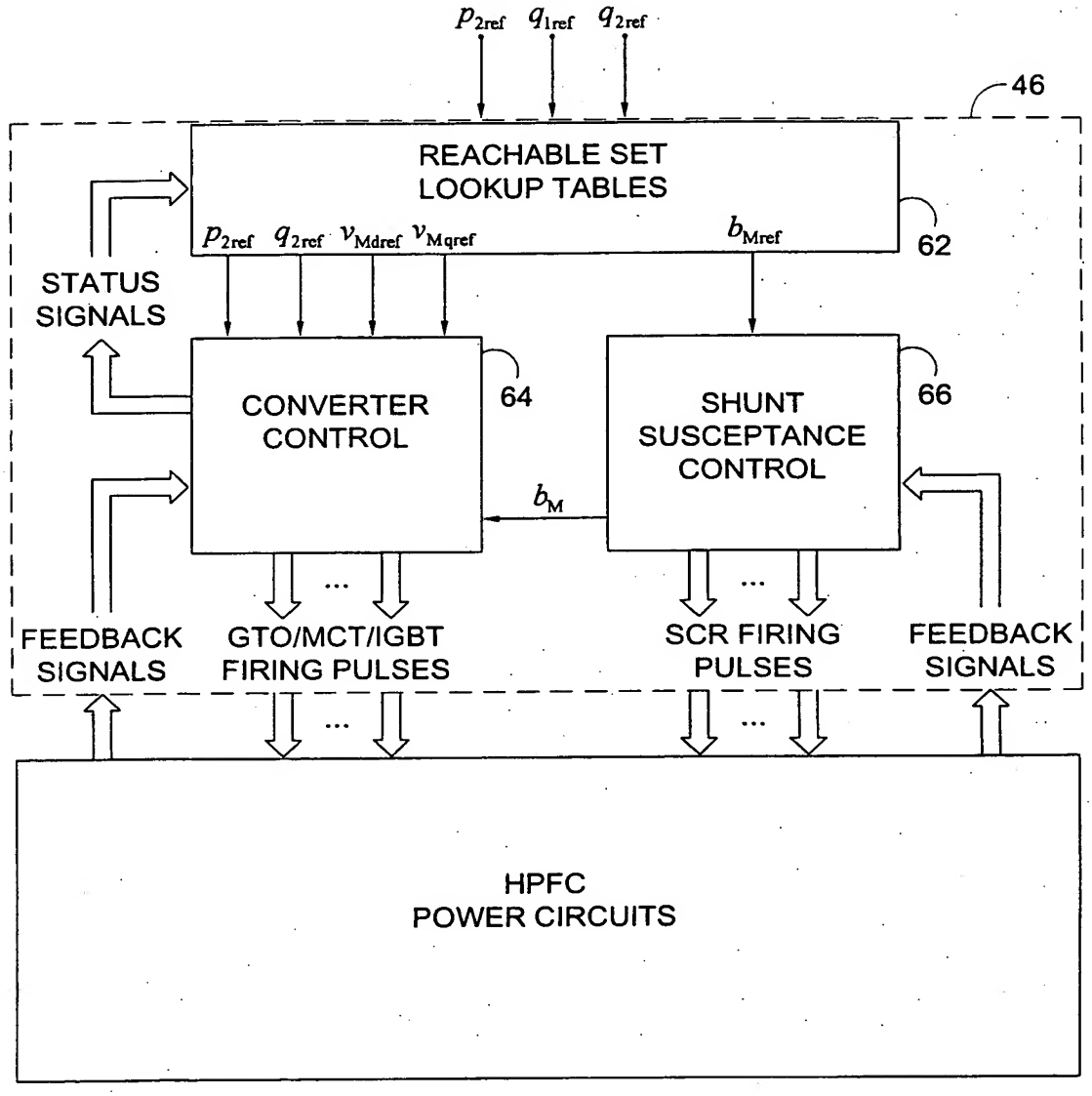

p_{2ref} q_{1ref} q_{2ref}
46
REACHABLE SET LOOKUP TABLES
p_{2ref} q_{2ref} v_{Mdref} v_{Mqref}
b_{Mref}
62
STATUS SIGNALS
CONVERTER CONTROL
64
SHUNT SUSCEPTANCE CONTROL
66
b_M
FEEDBACK SIGNALS
GTO/MCT/IGBT FIRING PULSES
SCR FIRING PULSES
FEEDBACK SIGNALS
HPFC POWER CIRCUITS

FIG. 15

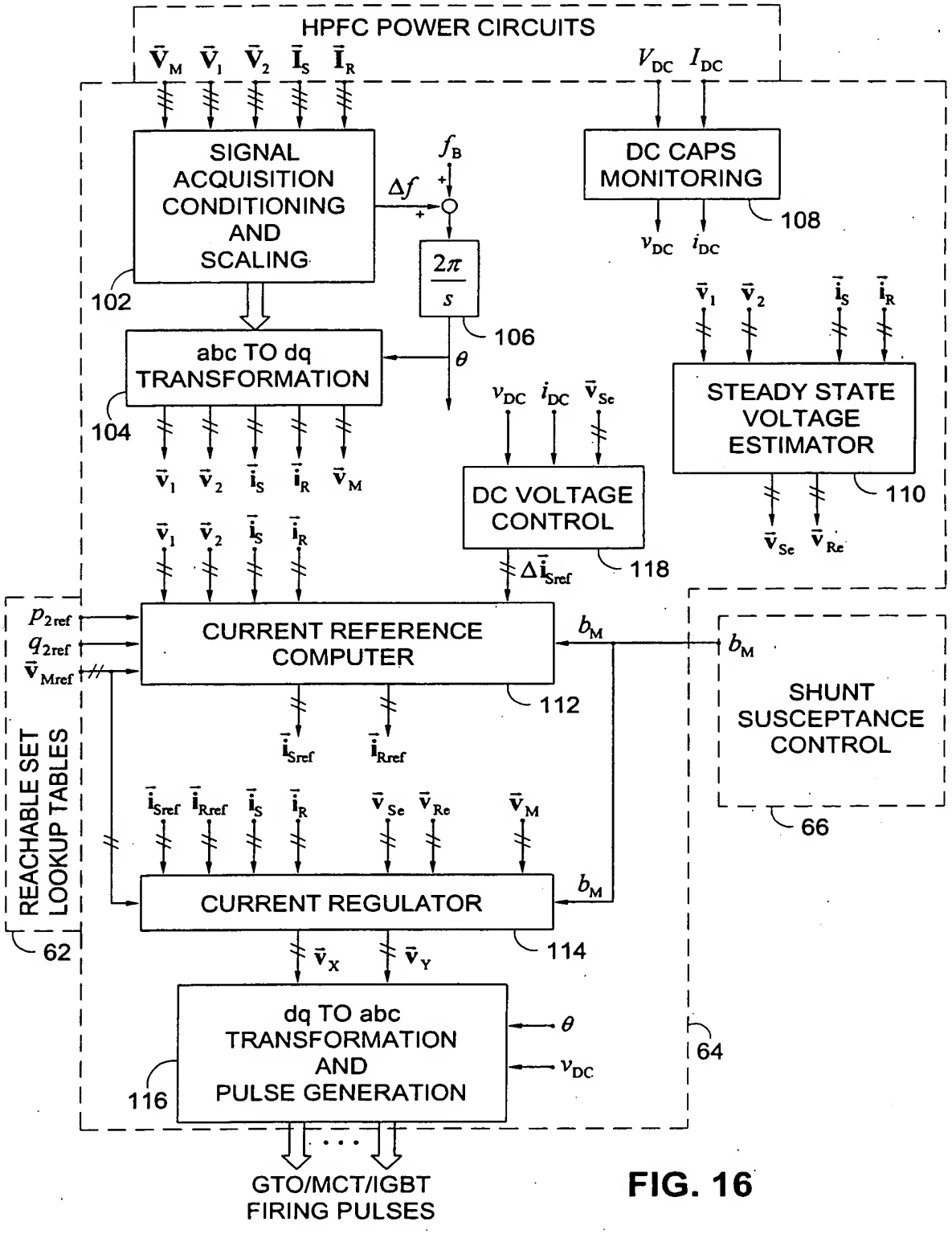

HPFC POWER CIRCUITS
SIGNAL ACQUISITION CONDITIONING AND SCALING
102
DC CAPS MONITORING
108
abc TO dq TRANSFORMATION
104
106
STEADY STATE VOLTAGE ESTIMATOR
110
DC VOLTAGE CONTROL
118
CURRENT REFERENCE COMPUTER
112
SHUNT SUSCEPTANCE CONTROL
66
CURRENT REGULATOR
114
REACHABLE SET LOOKUP TABLES
62
dq TO abc TRANSFORMATION AND PULSE GENERATION
116
64
GTO/MCT/IGBT FIRING PULSES

FIG. 16

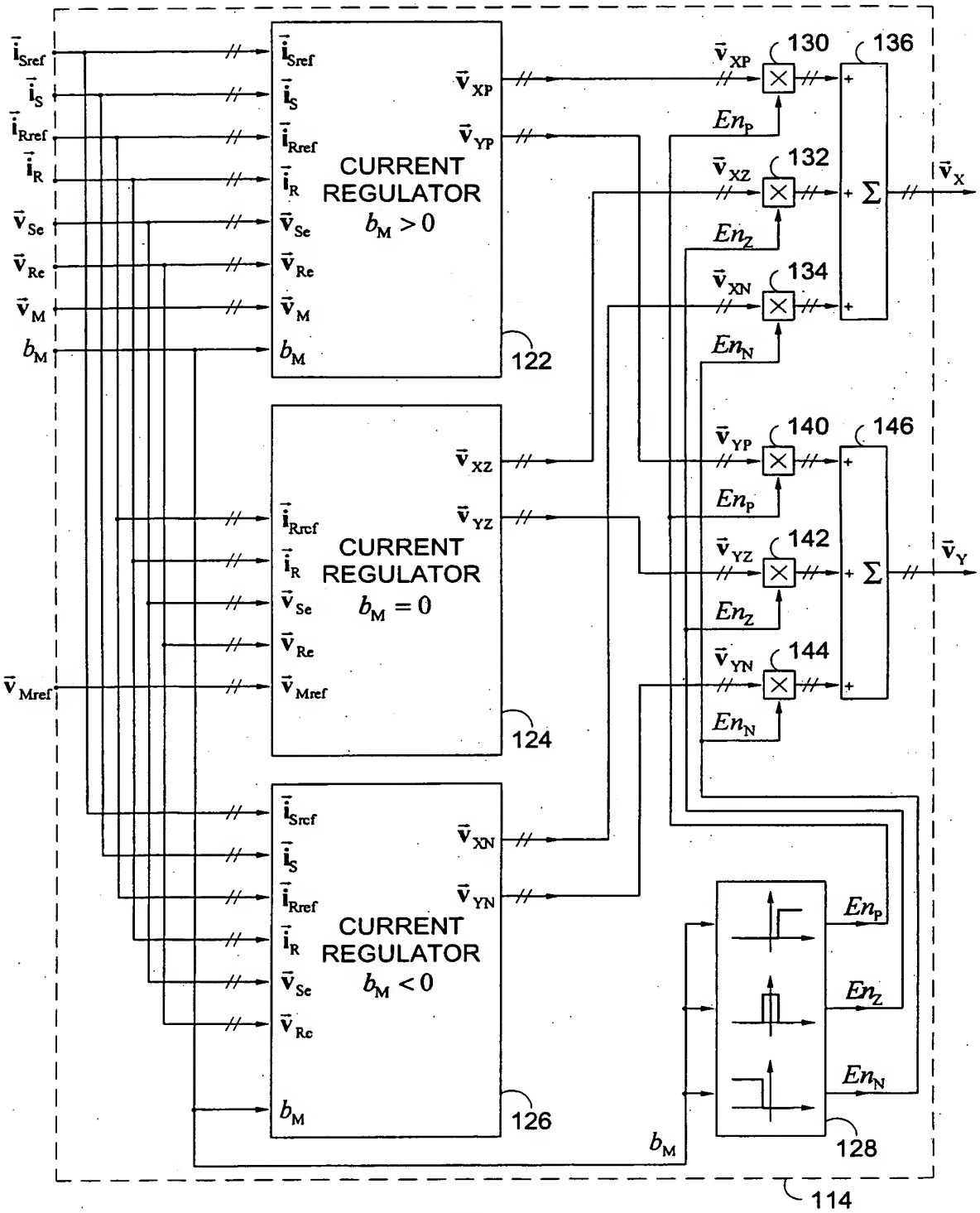

CURRENT REGULATOR
$b_M > 0$
122
CURRENT REGULATOR
$b_M = 0$
124
CURRENT REGULATOR
$b_M < 0$
126
130
132
134
136
140
142
144
146
128
114
$\vec{i}_{Sref}$
$\vec{i}_S$
$\vec{i}_{Rref}$
$\vec{i}_R$
$\vec{v}_{Se}$
$\vec{v}_{Re}$
$\vec{v}_M$
b_M
$\vec{v}_{Mref}$
$\vec{v}_{XP}$
$\vec{v}_{YP}$
$\vec{v}_{XZ}$
$\vec{v}_{YZ}$
$\vec{v}_{XN}$
$\vec{v}_{YN}$
$\vec{v}_X$
$\vec{v}_Y$
En_P
En_Z
En_N
Σ

FIG. 17

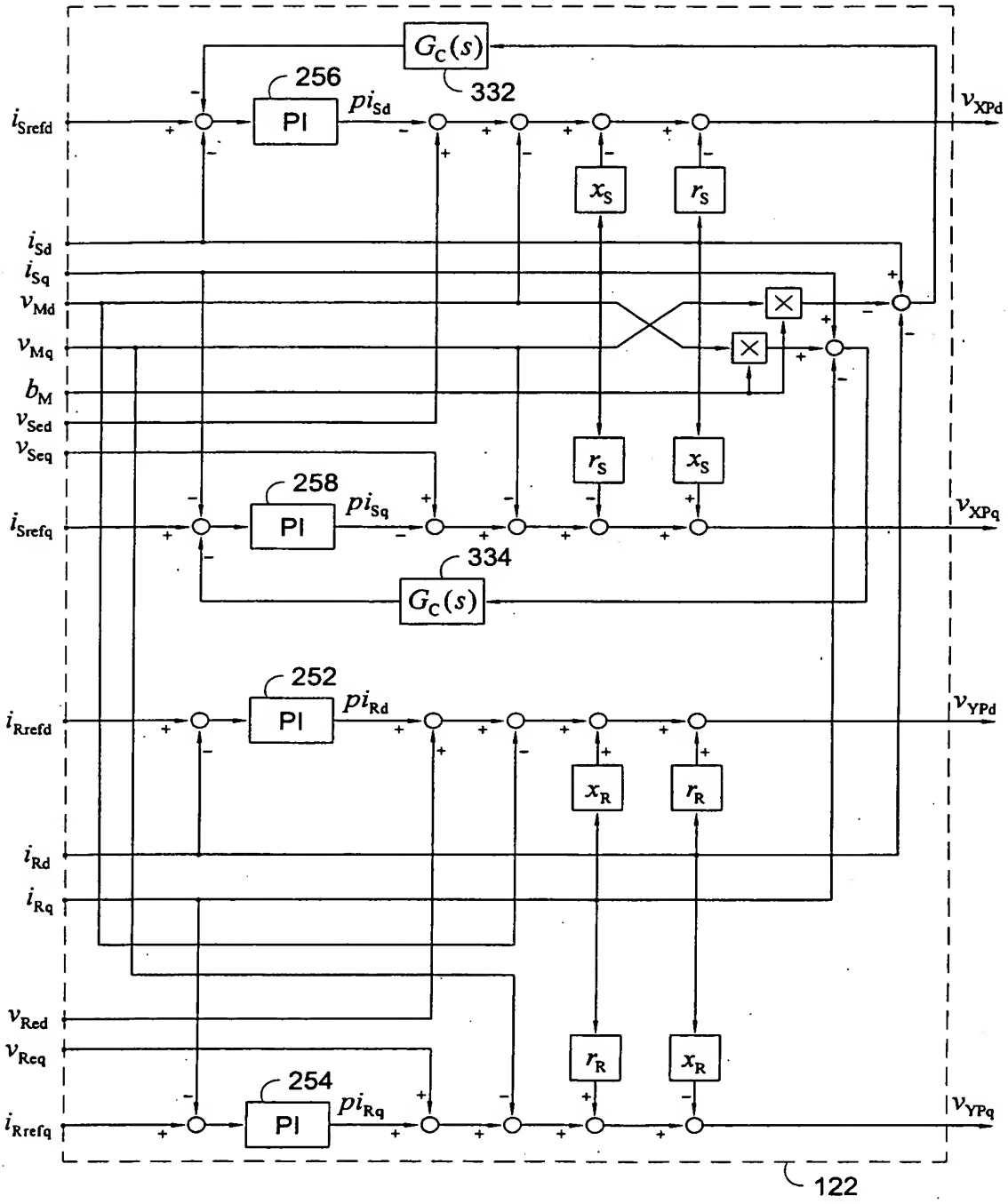

$G_C(s)$
256
PI
pi_{Sd}
332
i_{Srefd}
v_{XPd}
x_S
r_S
i_{Sd}
i_{Sq}
v_{Md}
v_{Mq}
b_M
v_{Sed}
v_{Seq}
r_S
x_S
258
PI
pi_{Sq}
i_{Srefq}
v_{XPq}
334
$G_C(s)$
252
PI
pi_{Rd}
i_{Rrefd}
v_{YPd}
x_R
r_R
i_{Rd}
i_{Rq}
v_{Red}
v_{Req}
r_R
x_R
254
PI
pi_{Rq}
i_{Rrefq}
v_{YPq}
122

FIG. 18

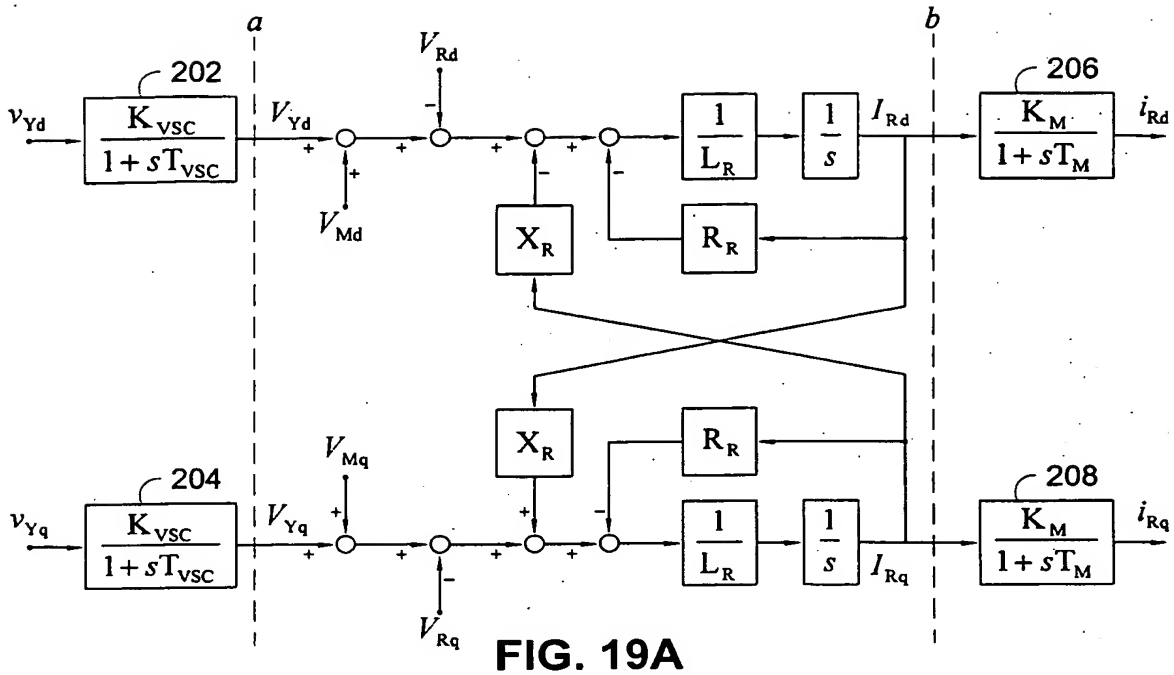


FIG. 19A

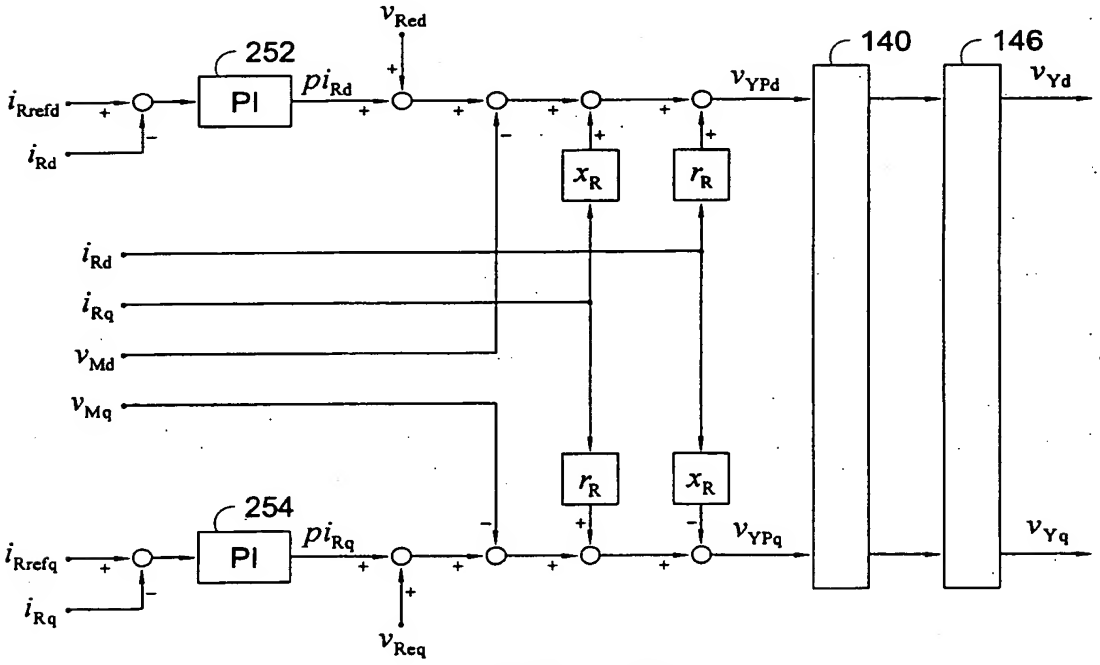


FIG. 19B

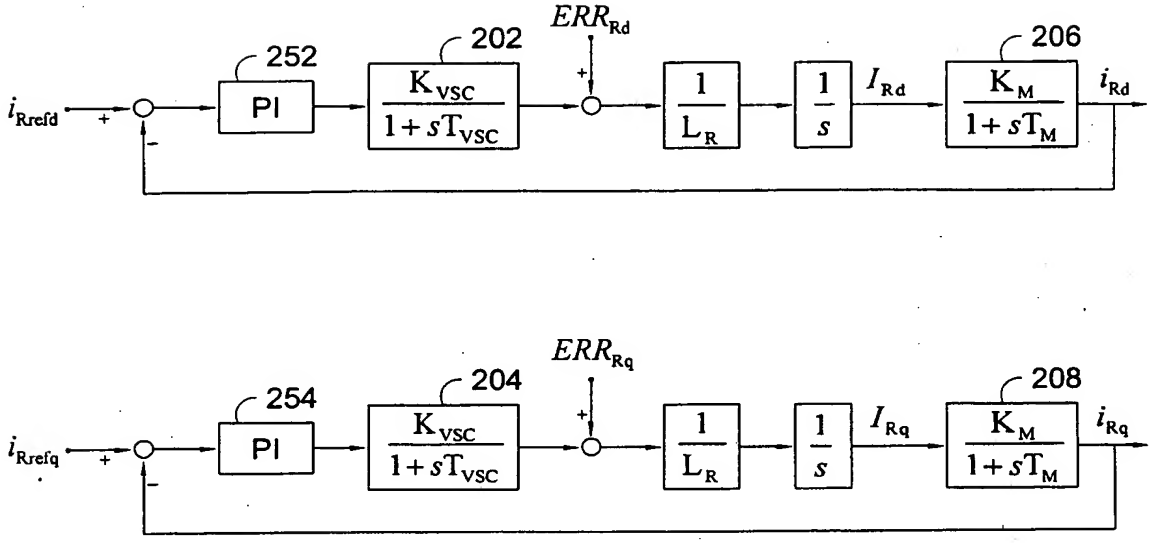


FIG. 19C

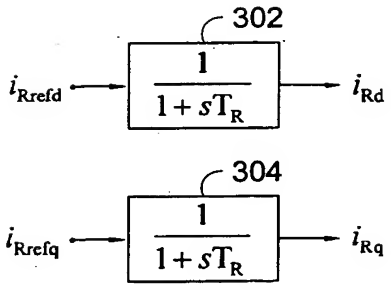


FIG. 19D

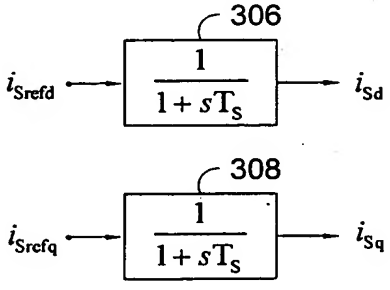


FIG. 19E

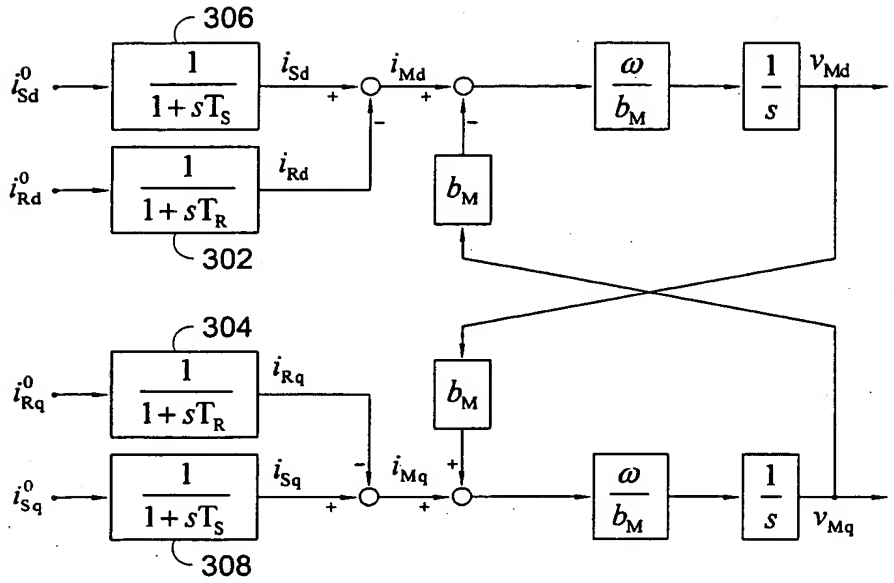
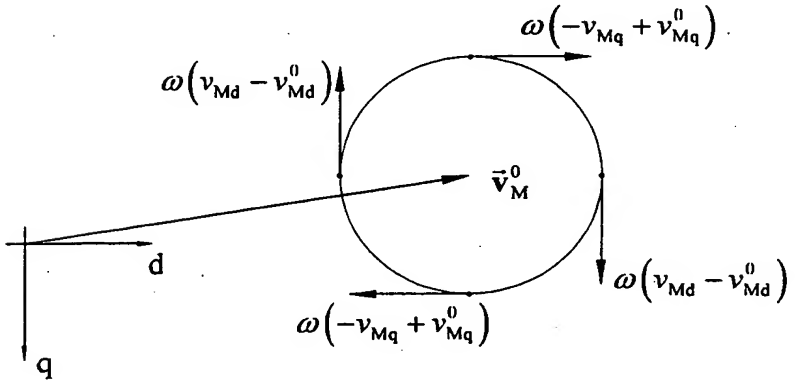


FIG. 20A



$$\omega\left(-v_{Mq}+v_{Mq}^0\right)=\lim_{t\to\infty}\frac{\omega}{b_M}\left(i_{Md}-b_M v_{Mq}\right)$$

$$\omega\left(v_{Md}-v_{Md}^0\right)=\lim_{t\to\infty}\frac{\omega}{b_M}\left(i_{Mq}+b_M v_{Md}\right)$$

FIG. 20B

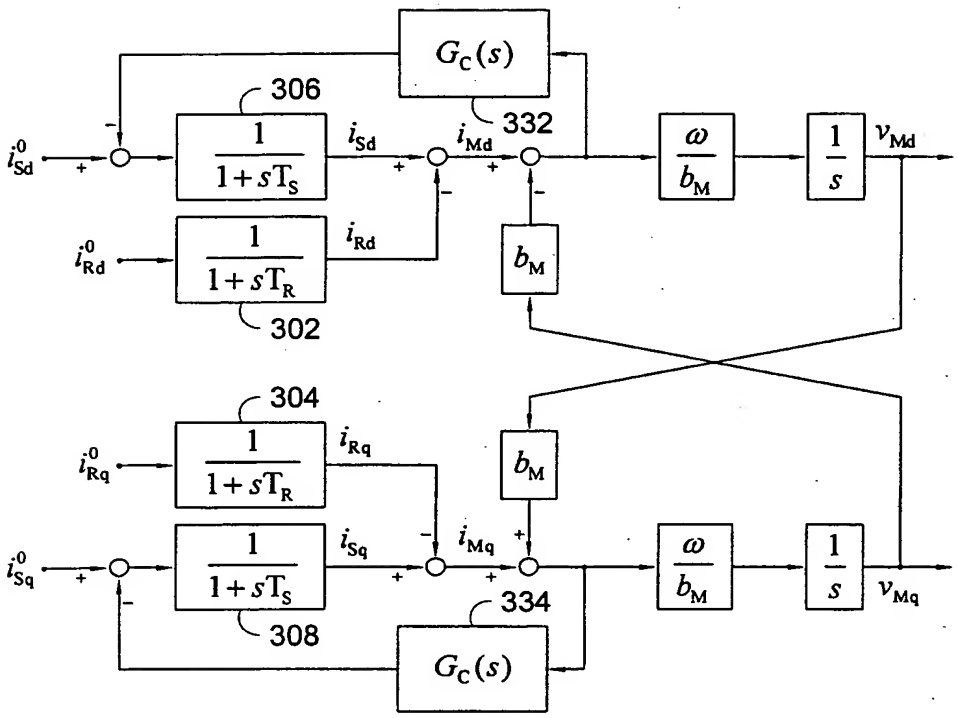


FIG. 21A

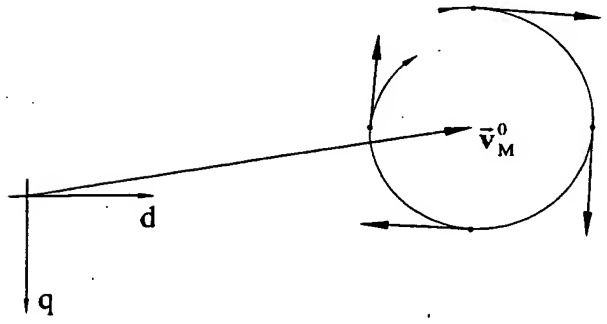


FIG. 21B

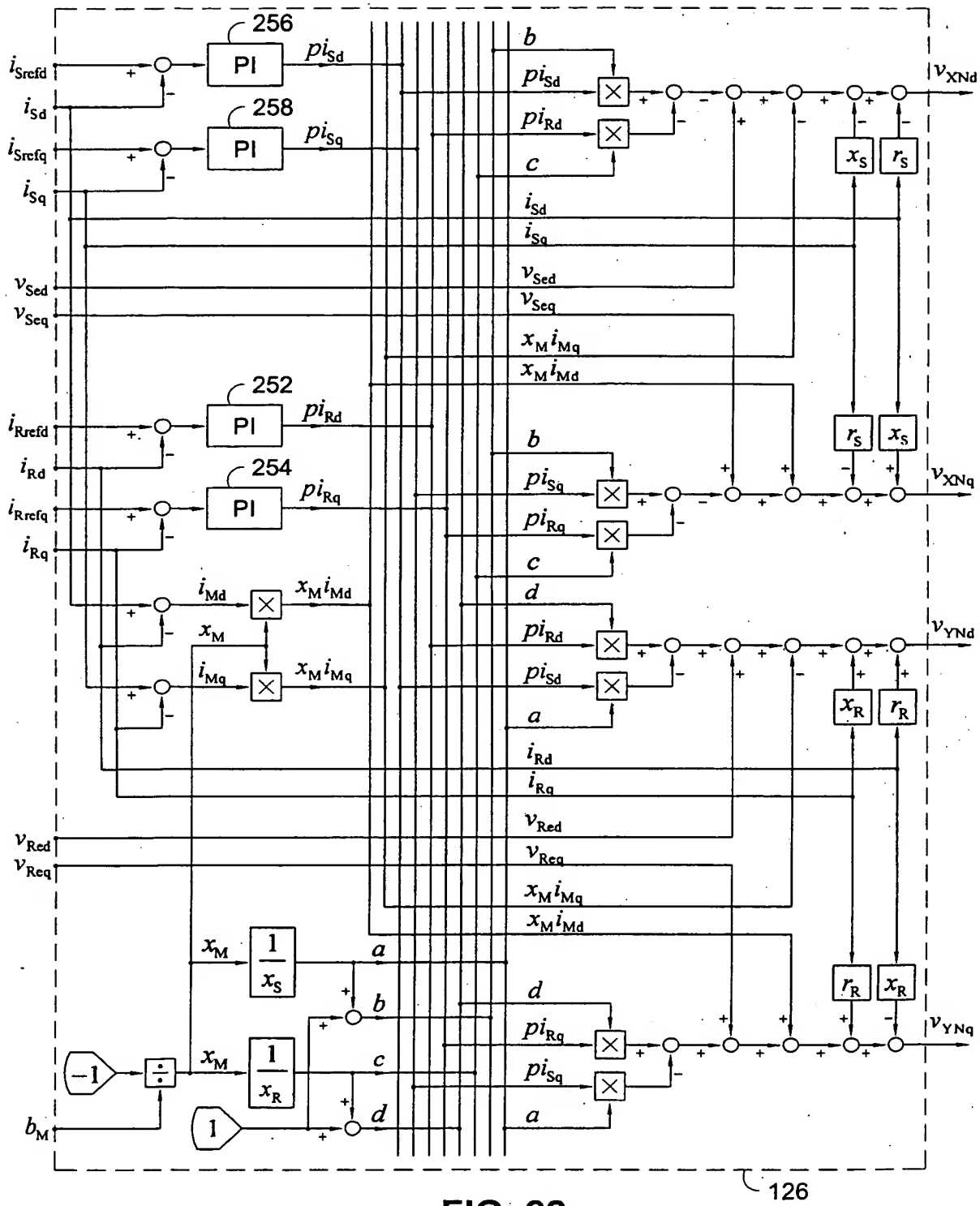

256
PI
258
PI
252
PI
254
PI
i_{Srefd}
i_{Sd}
i_{Srefq}
i_{Sq}
i_{Rrefd}
i_{Rd}
i_{Rrefq}
i_{Rq}
pi_{Sd}
pi_{Sq}
pi_{Rd}
pi_{Rq}
v_{Sed}
v_{Seq}
v_{Red}
v_{Req}
i_{Md}
i_{Mq}
x_M
$x_M i_{Md}$
$x_M i_{Mq}$
b_M
-1
1
$\frac{1}{x_S}$
$\frac{1}{x_R}$
a
b
c
d
x_S
r_S
x_R
r_R
v_{XNd}
v_{XNq}
v_{YNd}
v_{YNq}
126

FIG. 22

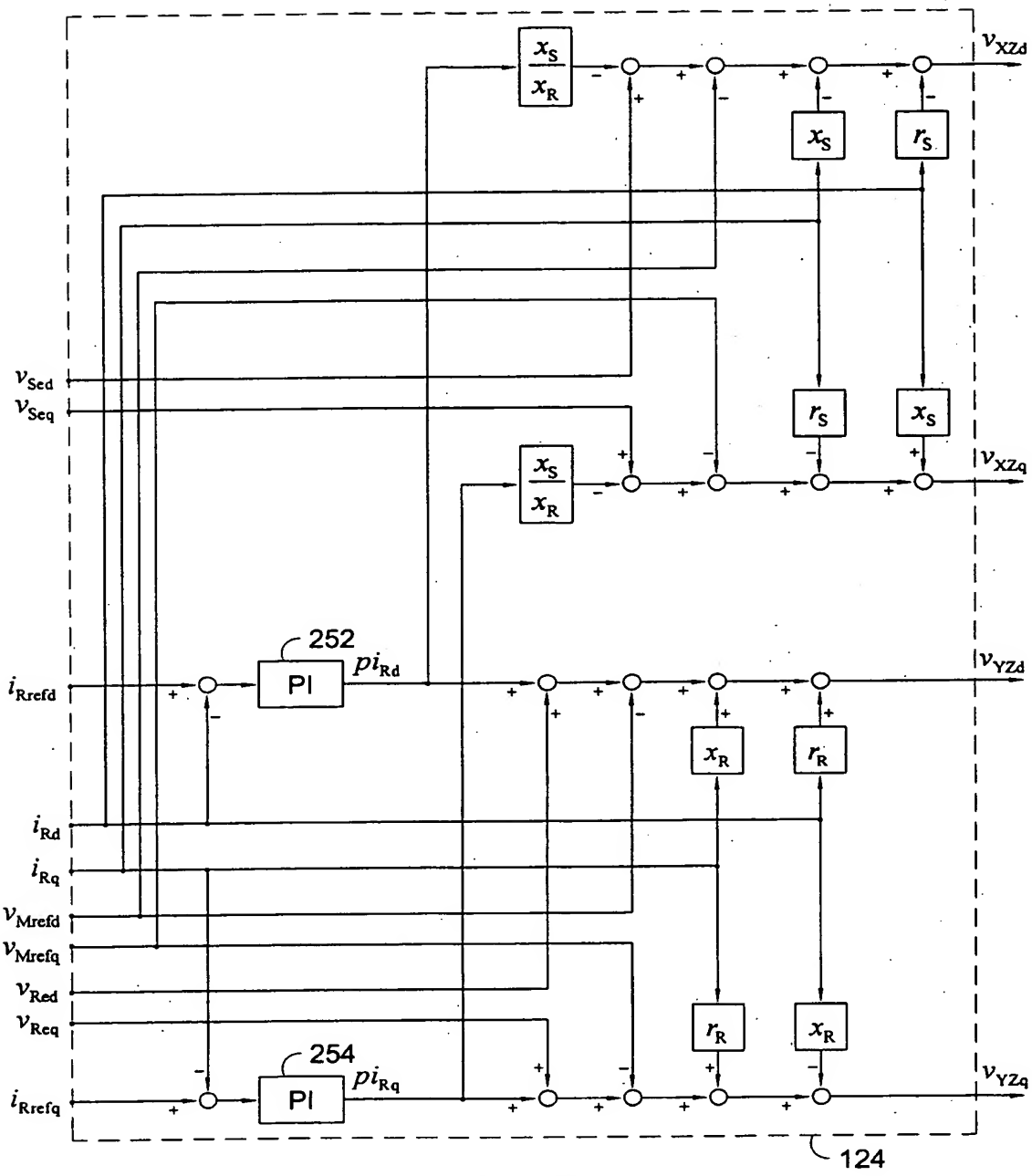

v_{XZd}
x_S/x_R
x_S
r_S
v_{Sed}
v_{Seq}
r_S
x_S
v_{XZq}
252
PI
pi_{Rd}
v_{YZd}
i_{Rrefd}
x_R
r_R
i_{Rd}
i_{Rq}
v_{Mrefd}
v_{Mrefq}
v_{Red}
v_{Req}
r_R
x_R
254
PI
pi_{Rq}
v_{YZq}
i_{Rrefq}
124

FIG. 23

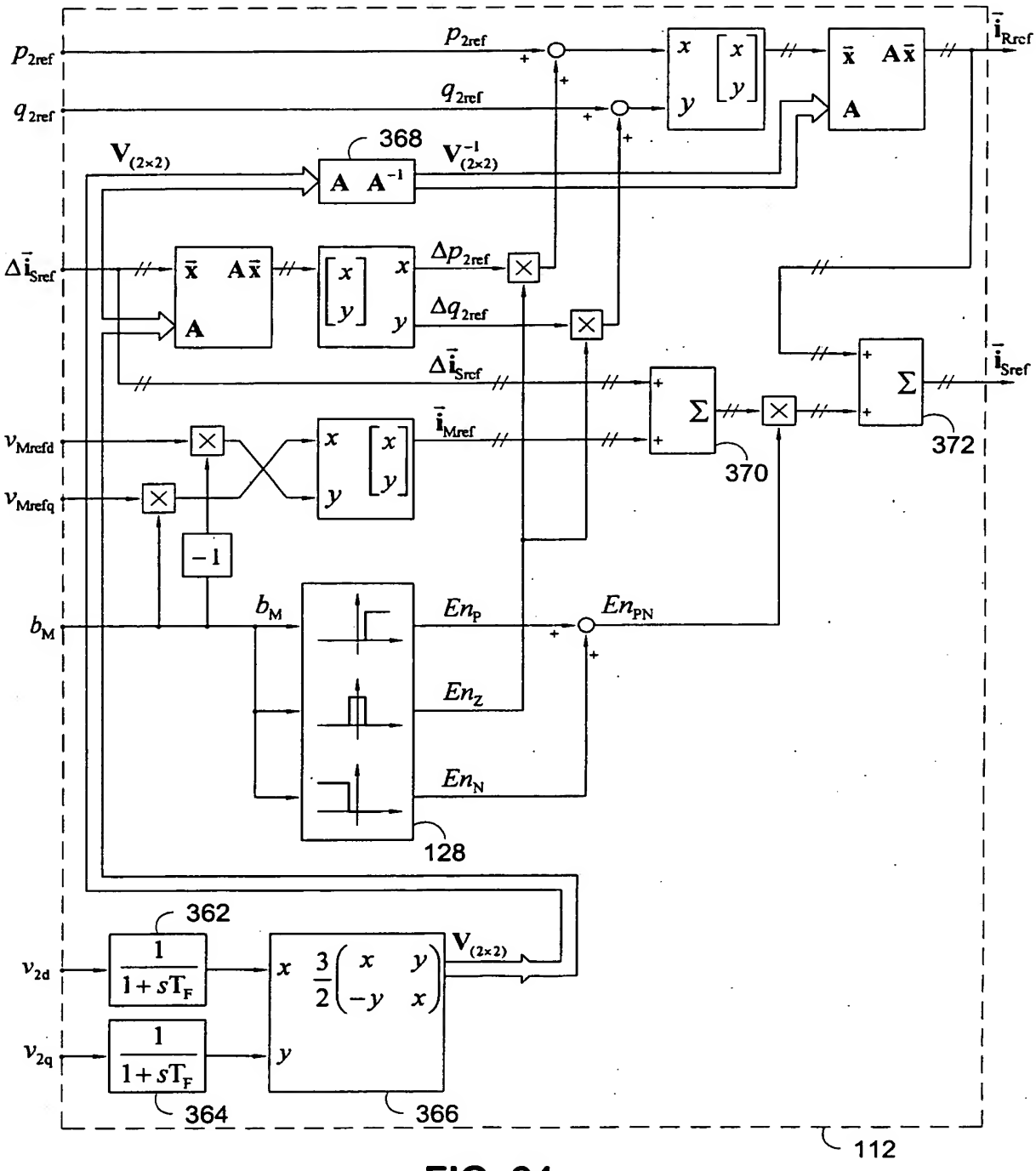

p_{2ref}
q_{2ref}
$\mathbf{V}_{(2\times2)}$
368
$\mathbf{A}\ \mathbf{A}^{-1}$
$\mathbf{V}^{-1}_{(2\times2)}$
$\Delta\bar{\mathbf{i}}_{Sref}$
$\bar{\mathbf{x}}\quad \mathbf{A}\bar{\mathbf{x}}$
$\mathbf{A}$
Δp_{2ref}
Δq_{2ref}
$\bar{\mathbf{i}}_{Rref}$
$\bar{\mathbf{i}}_{Sref}$
$\bar{\mathbf{i}}_{Mref}$
v_{Mrefd}
v_{Mrefq}
-1
Σ
370
372
b_M
En_P
En_{PN}
En_Z
En_N
128
362
v_{2d}
v_{2q}
$\frac{1}{1+sT_F}$
364
366
112

FIG. 24

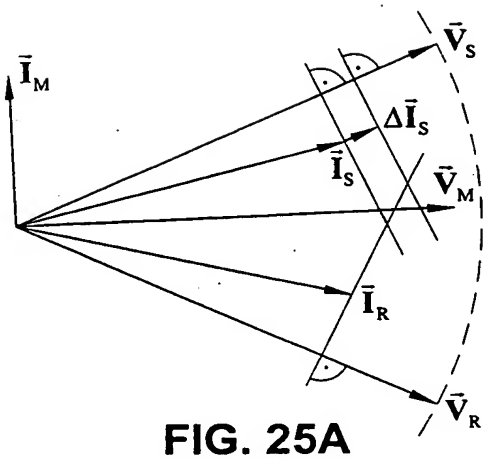


FIG. 25A

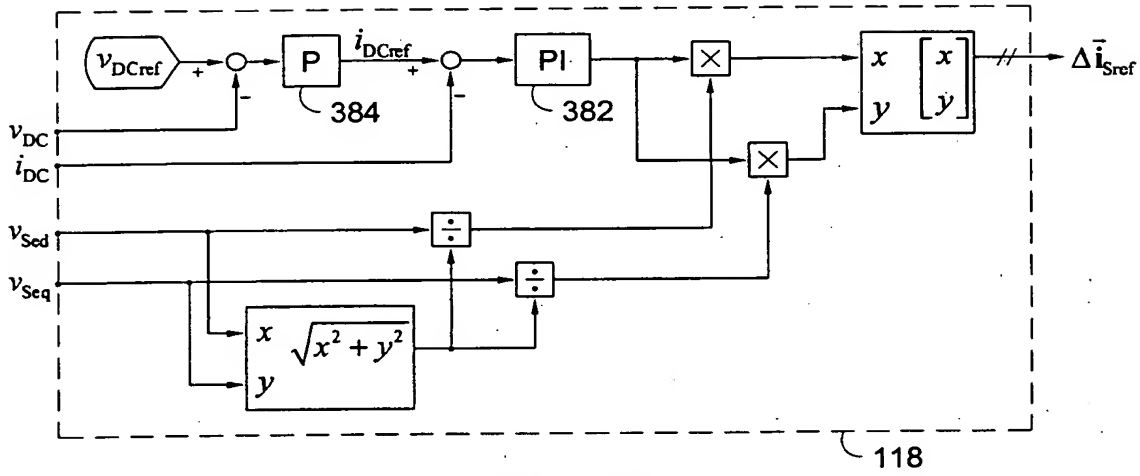


FIG. 25B

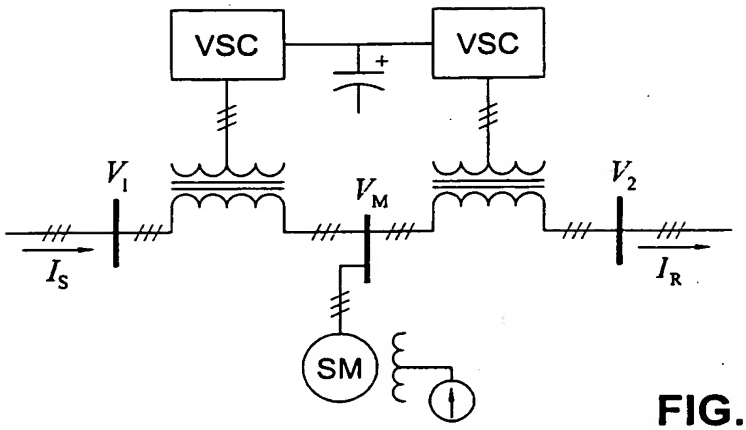


FIG. 26A

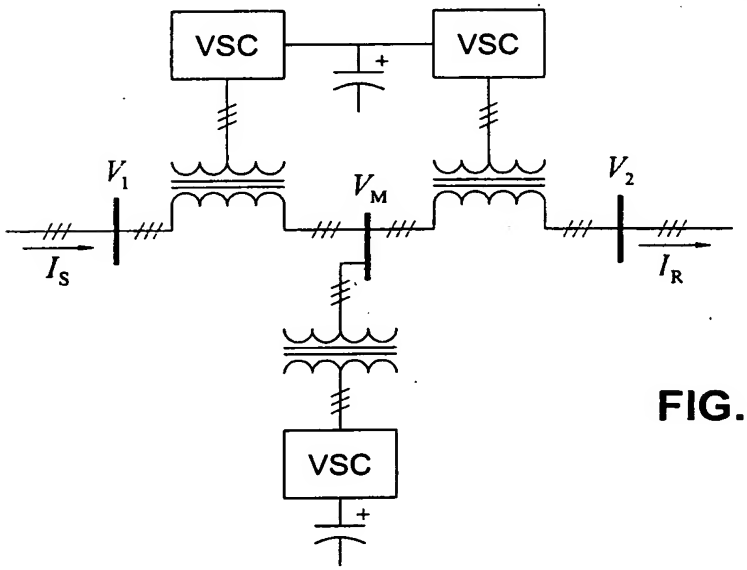


FIG. 26B

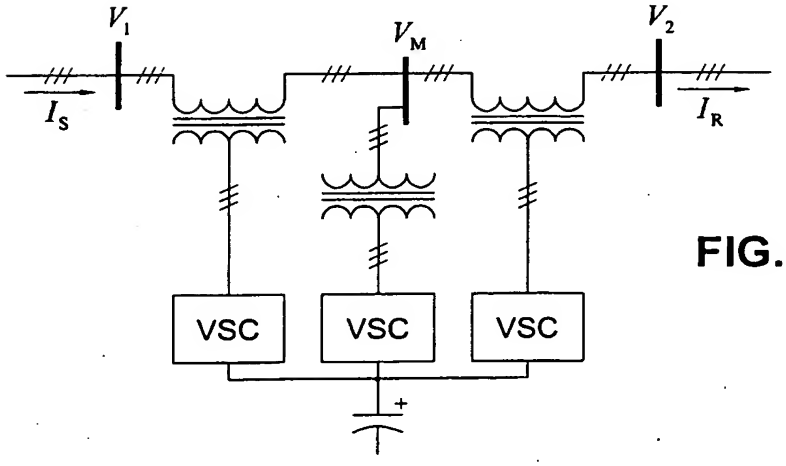


FIG. 26C

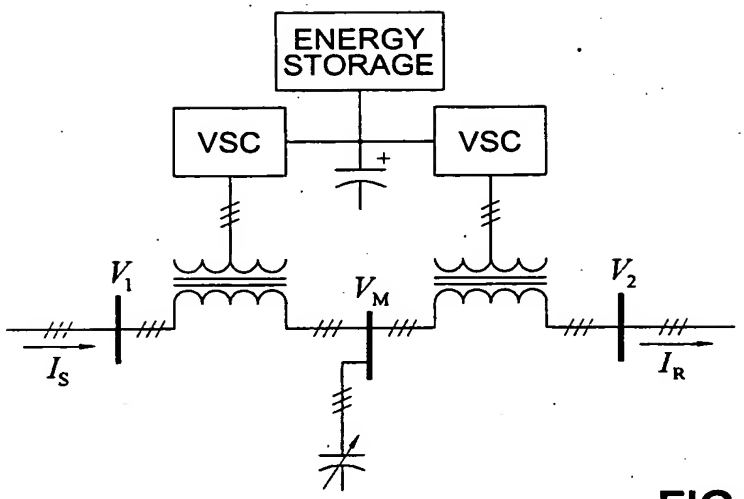


FIG. 27A

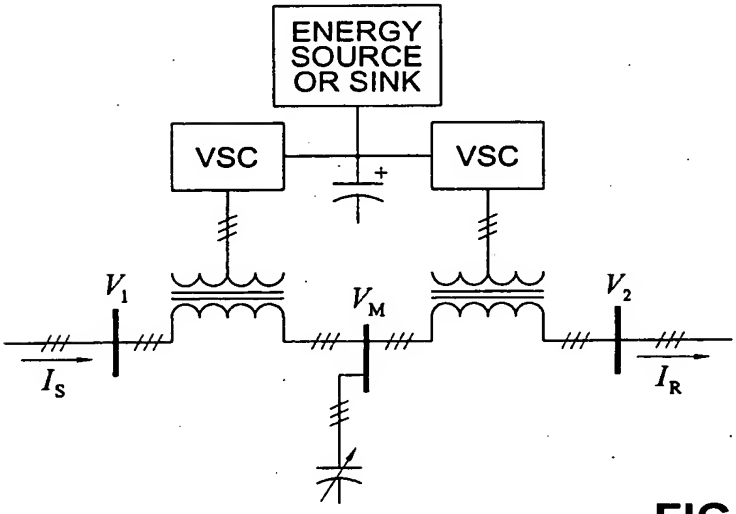


FIG. 27B

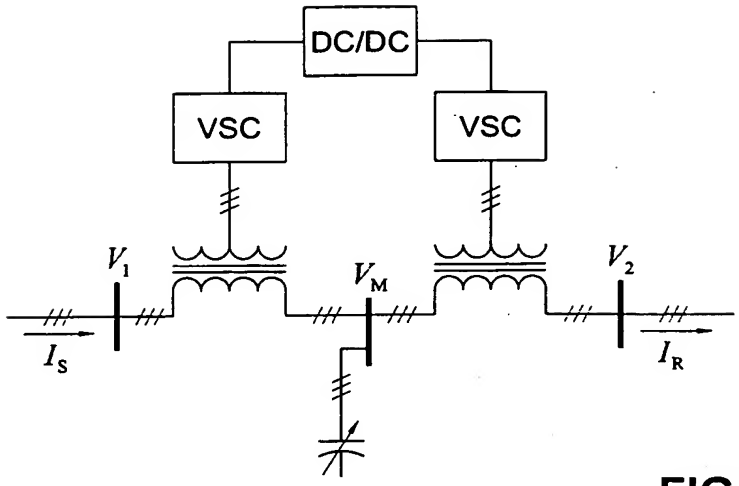


FIG. 28A

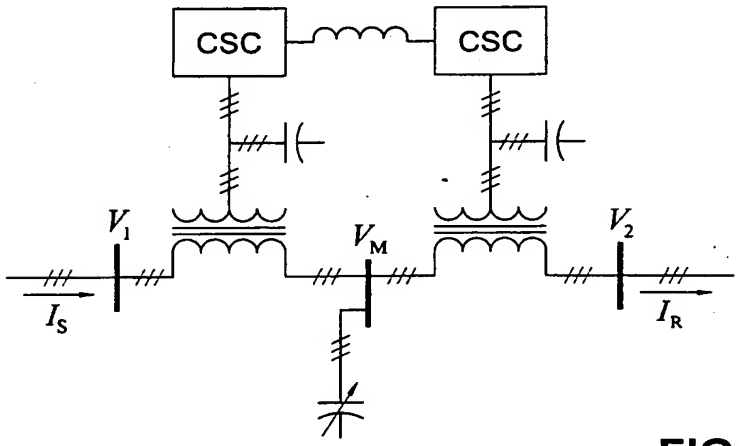


FIG. 28B

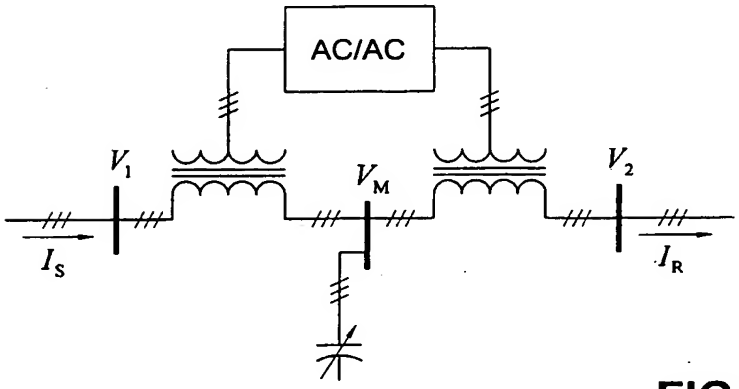


FIG. 28C

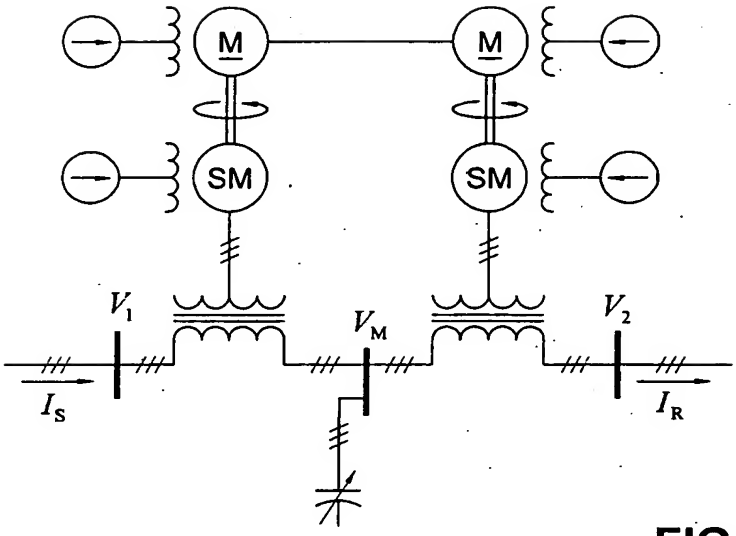


FIG. 29A

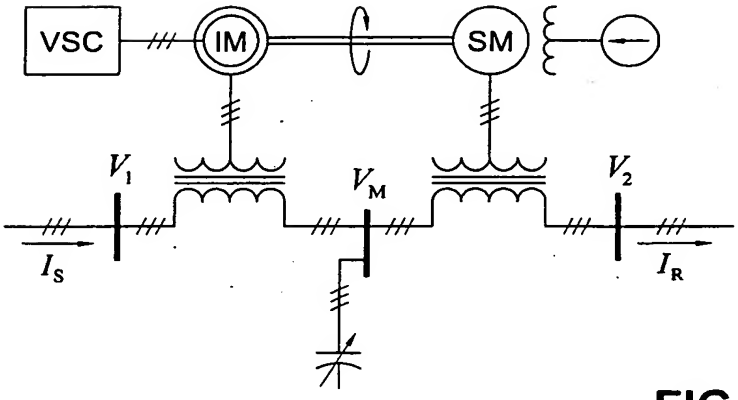


FIG. 29B

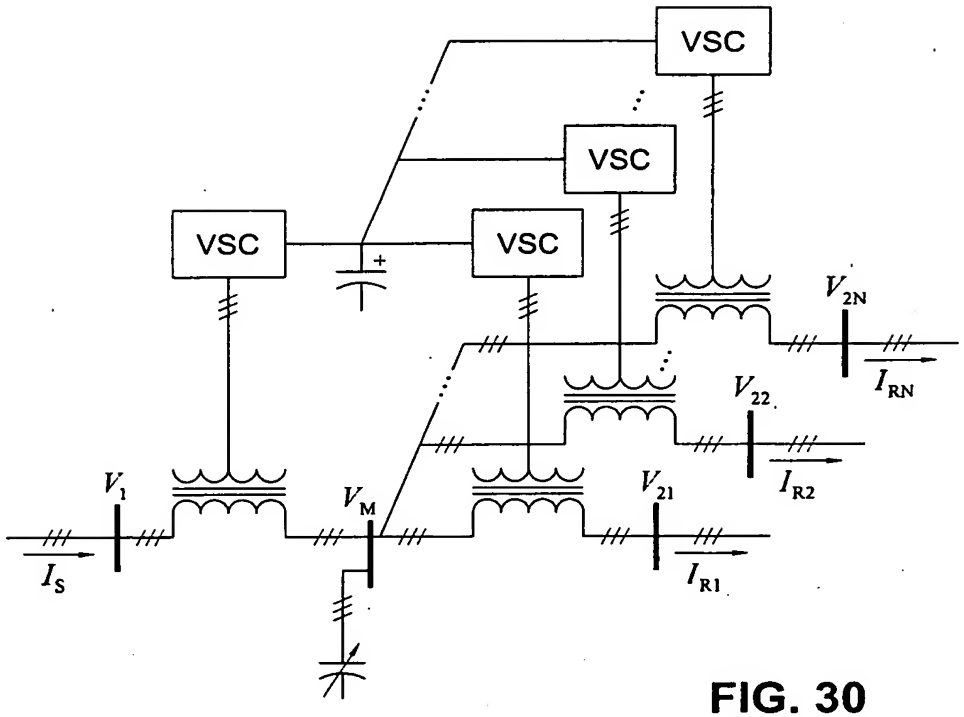


FIG. 30

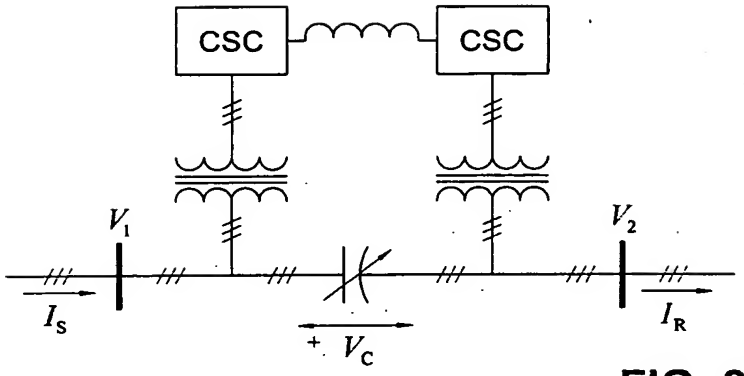


FIG. 31